ADVANCED FLOOD MODELLING FOR INSURANCE

REPLY DATA

INTRODUCTION

The activity aims the development of an **advanced flood risk modelling service** specifically tailored for insurance companies, utilizing satellite data and machine learning techniques to enhance flood risk assessments starting from **NatCat modeling theory** described as follows:

Hazard

Where it happens?
At which intensity?
How often?

Exposure

Where the assets are?
What type of assets?

Vulnerability

Where the damage respect to the hazard intensity?
What is the loss?

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MAIN NEEDS AND USE CASES

Enhanced Vulnerability Maps 

Enhanced Exposure Map 

Environmental Context Information 

 Multi-hazard understanding

 Expected Losses Prediction

 Mitigation Strategies Map

 Portfolio Risk Analysis

 Flood Risk Assessment for Underwriting

 Dynamic Pricing Models

Use case Scenarios

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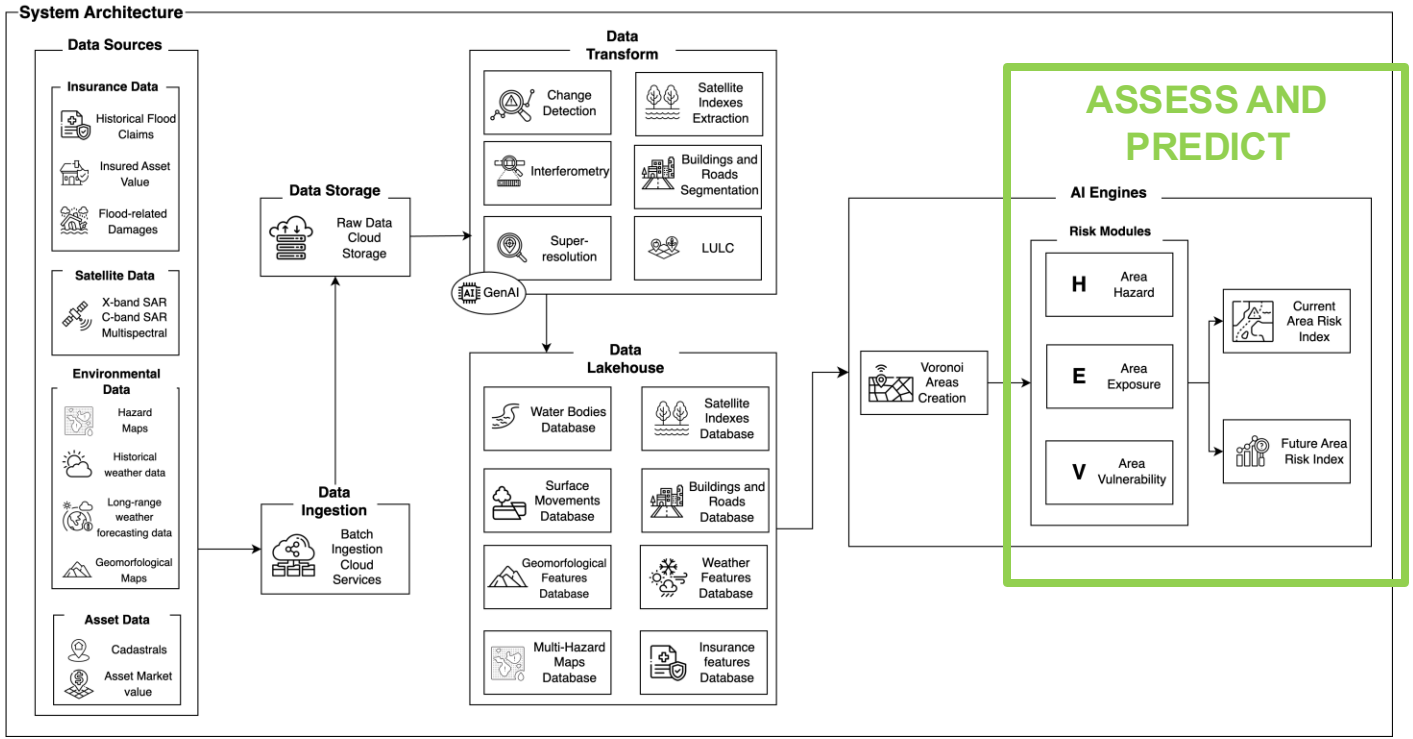
ARCHITECTURE



Current period = last 6 months

Future period = next 6 months

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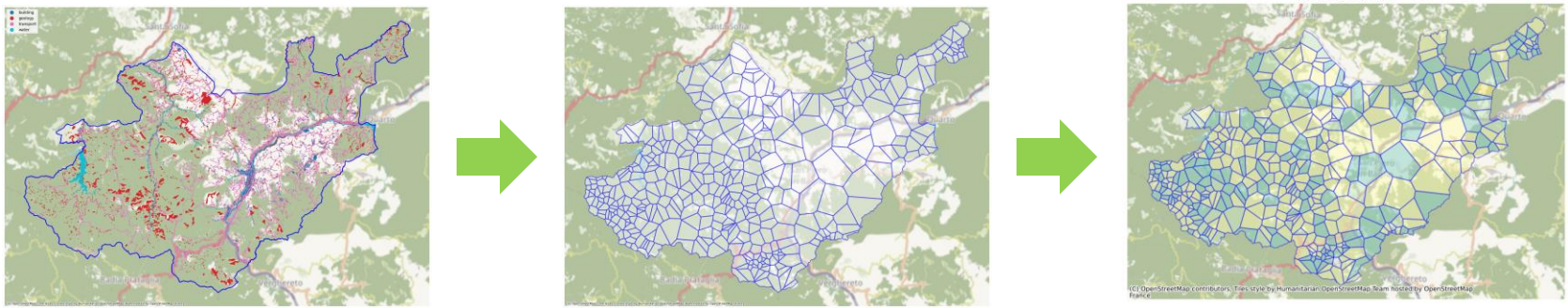
VORONOI AREAS CREATION

DEFINITION

The spatial resolution of our project is a Voronoi Area, which provides a more adaptable and insightful spatial framework for analyzing relationships and risk factors. This approach allows for tailored assessments that enhance decision-making, and its creation is adapted to the characteristics of each municipality.



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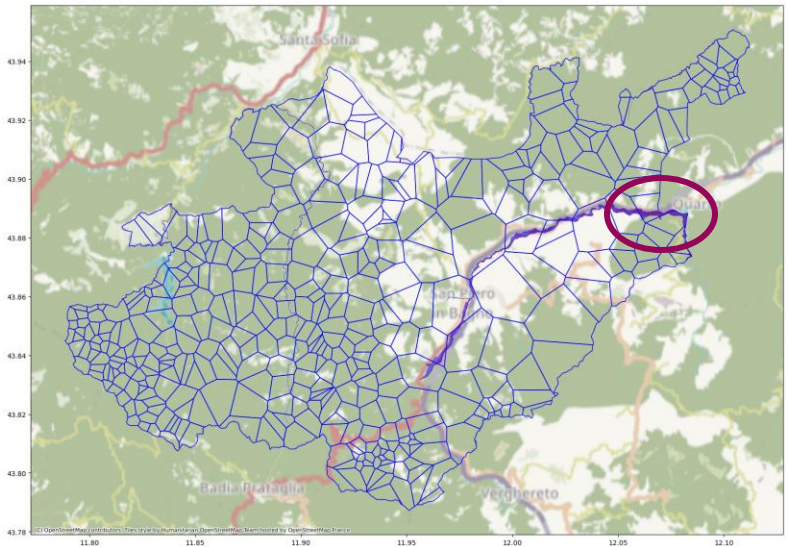
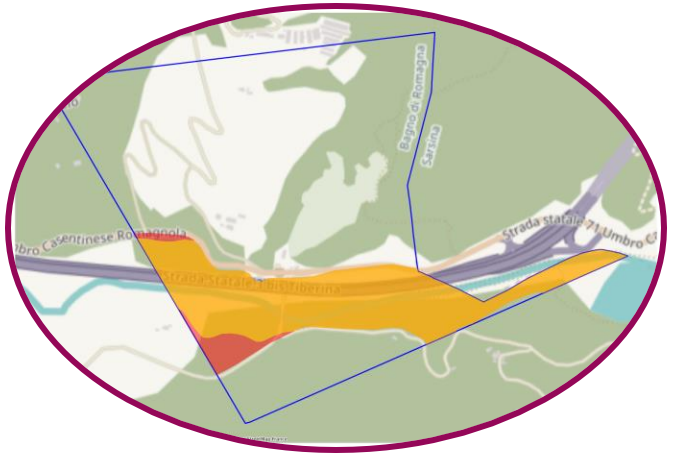
AREA HAZARD

DEFINITION

The Hazard refers to the potential occurrence of dangerous events that can impact assets, varying in nature and intensity. In a Voronoi area, the total hazard is characterized by the likelihood and severity of such events affecting the assets within. The severity of a flood is usually measured by the water depth.





Return Period 100/200 years – Medium Risk

Return Period 20/50 years – High Risk

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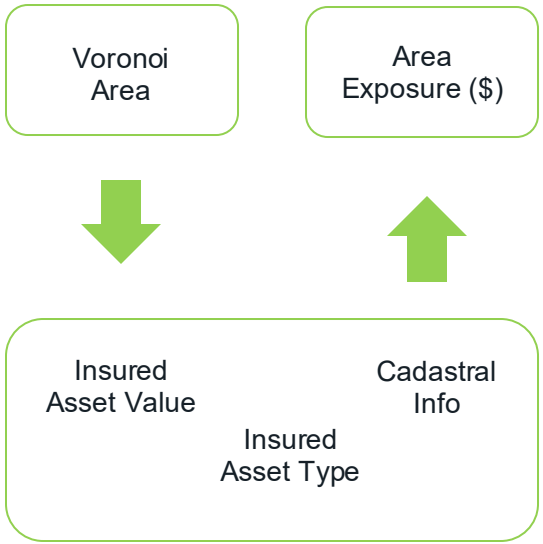
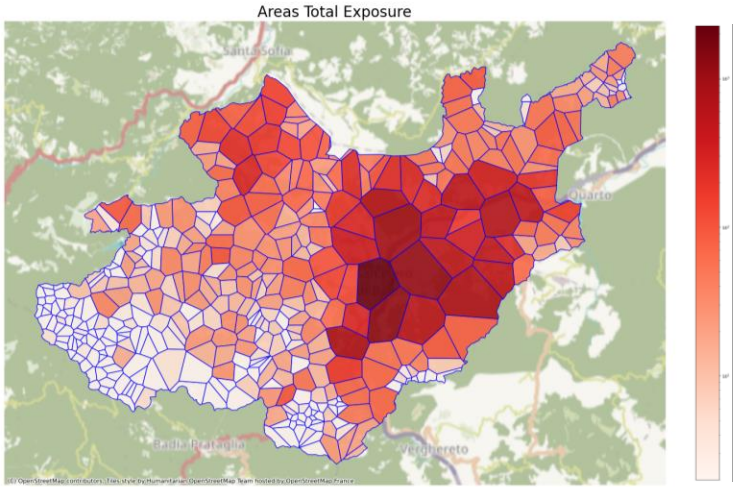
AREA EXPOSURE

DEFINITION

The Exposure represents the value of an asset that could be affected by hazardous events, depending on the category of each asset. In a Voronoi area, the total exposure is the sum of the exposure of all contained assets. Additionally, the value of assets not insured by the insurance company can be integrated from cadastral information.





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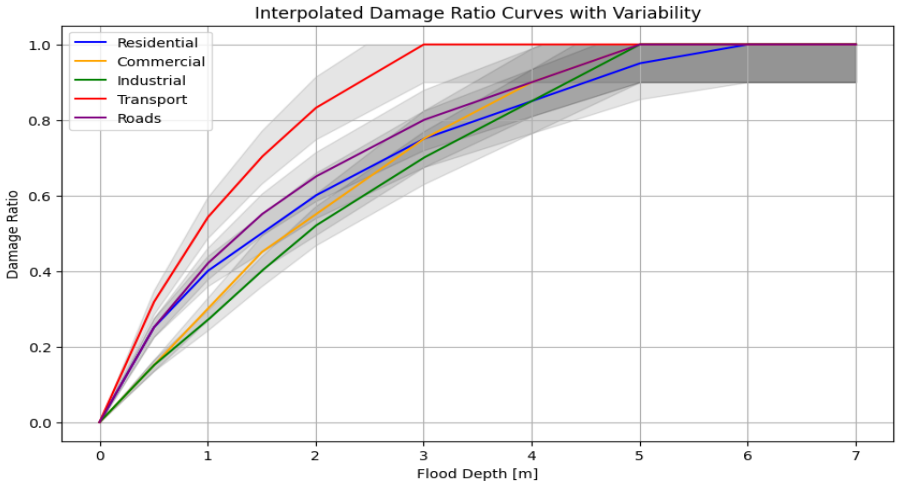
AREA VULNERABILITY

The Vulnerability refers to the susceptibility of assets to damage from hazardous events. To obtain it, relationships between hazard parameters and the expected damage to the elements needs to be estabilished. In flood risk, these relationships are referred to as «vulnerability curves». In a Voronoi Area the vulnerability is the mean damage ratio obtained considering the Voronoi Area environmental, antropic and metereological features.



Vulnerability Curves Creation

Current Damage Ratio Scenarios

Actual Damage Ratio

Future Damage Ratio Scenarios

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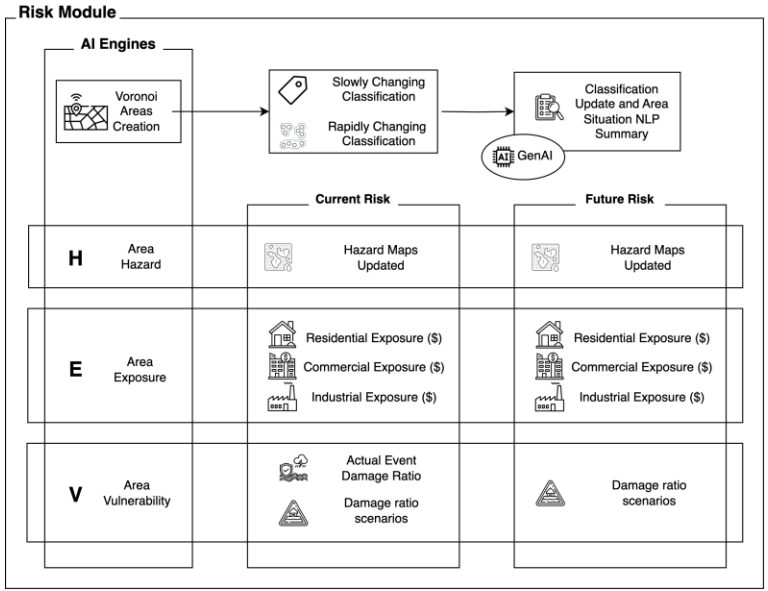
EXPLAINABLE RISK

DEFINITION

The Risk refers to the combination Hazard, Exposure and Vulnerability for each Voronoi area, providing both current state assessment and future projections crucial for decision-making



An examples of a Voronoi area Risk statistic (e.g mean, max etc)

$$R_{stat} = H * V_{stat} * (E_{res} + E_{ind} + E_{comm})$$

This modular approach allows for detailed, explainable, and updatable flood risk assessments, supporting insurance and disaster management decisions

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EXPLAINABLE RISK

DEFINITION

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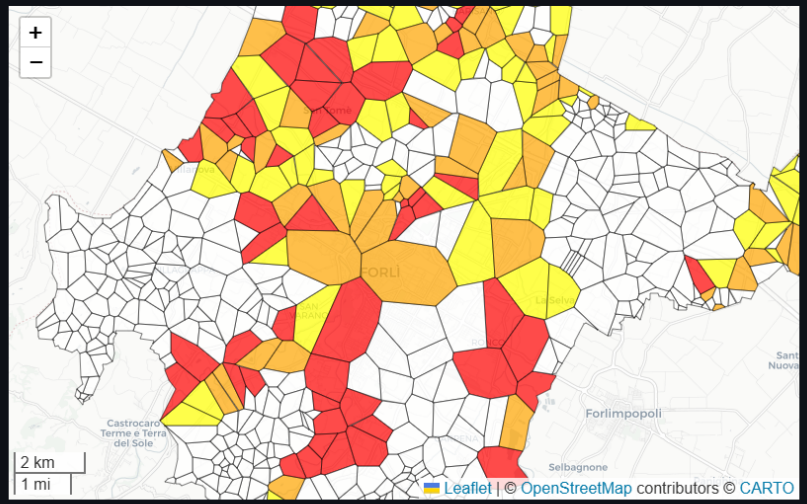
Risk Map - Forlì

The Risk Map provides an integrated assessment of flood risk by combining the results of the Hazard, Exposure, and Vulnerability components. It quantifies the potential adverse impacts of flood events by considering the likelihood of hazardous occurrences, the economic value of exposed assets, and their susceptibility to damage. This combined approach allows for a clear and comprehensive understanding of overall flood risk across the territory.



Risk description:
Terrain irregularities could be hindering effective water dispersion and vegetation appears stressed or patchy, reducing the land's ability to buffer rainfall and control runoff.

Hazard: This area has experienced repeated high-intensity rainfall, overwhelming natural and artificial drainage systems.

Vulnerability: Most buildings in this area are only marginally affected by flooding, indicating very low vulnerability.

Exposure: Extensive development with high-value assets leads to a very high exposure rating.

Risk class:

- Very low
- Low
- Discrete
- High
- Very High

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NEXT STEPS

INDUSTRIALIZE THE PROJECT AND MAKE IT OPERATIONAL

Defining a modular and scalable approach that can also be applied to other types of natural disasters.

Physical modeling remains the basis of risk analysis techniques. The support that comes from the combined use of satellite imagery and machine learning succeeds in building more accurate, up-to-date, and explainable analysis pipelines

Now the idea is to industrialize what we have seen so far, work on a larger area, and make it operational on the client

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